What we claimed is:

1. A fuel injector having a fuel inlet, a fuel outlet, and a fuel passageway extending from the fuel inlet to the fuel outlet along a longitudinal axis, the fuel injector comprising:

a body having an inlet portion, an outlet portion, a neck portion disposed between the inlet portion and the outlet portion, the neck portion including a cylindrical annulus that provides a body passage extending from the inlet portion to the outlet portion along the longitudinal axis of the fuel injector;

an armature proximate the inlet portion of the body;

a cylindrical needle operatively connected to the armature;

a seat disposed at the outlet portion of the body; and

a swirl generator proximate the seat;

wherein the cylindrical annulus of the body includes an inner diameter that is greater than a diameter of the cylindrical needle so as to define the body passage, which maintains an operative relationship between the body and the needle.

2. The fuel injector of claim 1, wherein the inner diameter of the cylindrical annulus is no more than 50% greater than the diameter of the cylindrical needle, and an outer diameter of the cylindrical annulus is no less than 100% greater than the inner diameter of the cylindrical annulus.

3. The fuel injector of claim 1, wherein the seat comprises a first surface exposed to the fuel passageway and a second surface exposed to an exterior of the fuel injector, the first surface being spaced from the second surface a defined distance along the longitudinal axis, the first portion having at least one cut-out configuration that extends for a fraction of the defined distance into an interior of seat.

4. The fuel injector of claim 3, wherein the at least one cut-out comprises at least one volume that defines at least one wall that is located between the first surface and the second surface.

5. The fuel injector of claim 4, where the at least volume comprises one of a plurality of volumes and a channel.

6. A fuel injector having a fuel inlet, a fuel outlet, and a fuel passageway extending from the fuel inlet to the fuel outlet along a longitudinal axis, the fuel injector comprising:

a body having an inlet portion, an outlet portion, and a body passage extending from the inlet portion to the outlet portion along the longitudinal axis;

an armature proximate the inlet portion of the body;

a needle operatively connected to the armature;

a swirl generator proximate the needle;

a seat disposed at the outlet portion of said body, the seat including a first surface exposed to the body passage and a second surface exposed to an exterior of the fuel injector, the first surface being spaced from the second surface a defined distance along the longitudinal axis, the first portion having at least one cut-out configuration that extends from the first surface for a fraction of the defined distance into an interior of seat.

7. The fuel injector of claim 6, wherein the at least one cut-out comprises at least one volume that defines at least one wall in the interior of the seat.

8. The fuel injector of claim 7, wherein the at least one volume comprises one of a plurality of volumes and a channel.

9. The fuel injector of claim 8,

wherein the swirl generator comprises at least one flat disk;

wherein the seat includes a seat passage, the seat passage including a funnel extending between the first surface and the second surface; and

wherein the needle includes a curved surface that engages with a conical end of the funnel to inhibit fuel flow through the seat passage of the seat.

10. The fuel injector according to claim 9, wherein the at least one flat disk comprises:

a guide disk having a perimeter, a central aperture, and at least one fuel passage opening between the perimeter and the central aperture; and

a swirl disk having at least one slot extending tangentially from the at least one fuel passage opening to the central aperture.

11. The fuel injector of claim 10, wherein the at least one fuel passage opening comprises a plurality of fuel passage openings between the perimeter and the central aperture; and the at least one slot of the swirl disk comprises a plurality of slots that corresponds to the plurality of fuel passage openings in the guide disk.

12. The fuel injector of claim 11, wherein the at least one volume comprises a plurality of volumes arranged in the first surface to correspond to the plurality of fuel passage openings.

13. The fuel injector of claim 12, wherein each of the plurality of volumes comprises a cylindrical volume having a first diameter, and wherein the each of the plurality of fuel passage openings comprises a circular aperture having a second diameter, the first diameter being substantially equal to the second diameter.

14. The fuel injector of claim 13, wherein the at least one wall defined by each of the cylindrical volumes comprises a cylinder side wall and a cylinder end wall in the interior of the seat.

15. The fuel injector of claim 14, wherein the cylinder end wall is located between the second surface and a midpoint along the define distance from the first surface and the second surface.

16. The fuel injector of claim 8, wherein the channel comprises a width on the first surface, and wherein each of the plurality of fuel passage openings comprises a circular

aperture with a diameter, the diameter of one of the fuel passage openings being substantially equal to the width of the channel.

17. The fuel injector of claim 16, wherein the channel comprises a continuous channel, and wherein the at least one wall defined by the continuous channel comprises an inner side wall, an outer side wall, and a channel end wall engaging both the inner side wall and the outer side wall.

18. The fuel injector of claim 17, wherein the channel end wall is located between the second surface and a midpoint along the define distance from the first surface and the second surface.

19. The fuel injector of claim 8, wherein the body comprises a neck portion, the neck portion including a cylindrical annulus that surrounds the needle, the needle being a substantially cylindrical needle; and

wherein the cylindrical annulus comprises an inner diameter and an outer diameter, the inner diameter that is no more than 50% greater than a diameter of the cylindrical needle, and an outer diameter that is no less than 100% greater than the inner diameter.

20. A method of stabilizing temperature of a fuel injector in a direct injection application, the fuel injector having a body; an armature proximate an inlet of the body; a needle operatively connected to the armature; a seat disposed at the outlet of the body; and a swirl generator proximate the seat, the method comprising:

providing the needle with a substantially uniform cross-sectional area; and

selecting the body to surround the needle and form a body passage, the body passage maintains an operative relationship between the body and the needle;

wherein fuel in the body passage transfers heat from the body to the needle to maintain a minimum temperature gradient and to maintain an operative relationship between the body and the needle.

21. The method of claim 20, wherein the average cross-sectional area of the body passage is less than 2.25 times the substantially uniform cross-sectional area of the needle.

22. The method of claim 20, wherein the step of providing further comprises providing a substantially cylindrical member as the needle, and a cylindrical annulus as a neck of the body, the cylindrical annulus having an inner diameter that is no more than 50% greater than substantially uniform diameter of the substantially cylindrical member, and an outer diameter that is no less than 100% greater than the inner diameter.

23. The method of claim 22, further comprising:

providing the seat with a first surface exposed to the fuel passageway and a second surface exposed to an exterior of the fuel injector; and

configuring at least one cut-out in the first surface to form a wall that extends into an interior of seat.